Welfare Implications of Alternative Pension Policies

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Introduction

Motivation

- U.S. public pensions are underfunded (average 66%)
- Pension reforms underway in multiple states
  - Benefit reductions
  - Shift to DC
  - Always controversial
- Policy choices should account for all groups
  1. pension recipients
  2. non-recipient taxpayers

Question: What is the welfare impact of public pension reforms on groups (1) and (2), and across different age cohorts?

- Today: A hybrid DB/DC plan with wage compensation
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**Model Framework**

- Lifecycle model with portfolio choice and fixed retirement age
- Three main agents:
  - Public pension worker
  - Private DC worker
  - (State) Government

**Results**: Apply to Minnesota. For hybrid DB/DC reform,

- Young public workers require $\sim 5\%$ wage compensation
  - Older cohorts range from 10-25%
- If public workers receive full compensation, private sector workers suffer welfare loss (via higher tax)
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Model
Public Worker

- Agents born at age 20, work, then retire at 65
- Face three sources of risk
  1. mortality
  2. market
  3. labor income
- Exogenous stochastic labor income process $Y_{t}^{pub}$
  \[
  \log(Y_{t}^{pub}) = f(t, Z_{t}) + \nu_{t} + \eta_{t}
  \]
  where $f(t, Z_{t})$ is common component, $\nu_{t} \sim N(0, \sigma^{\nu})$ and $\eta_{t} \sim AR(1)$.
- In retirement, receive pension benefit $b + \text{social security } ss^{pub}$
An age $t$ public worker solves the Bellman

$$V^{pub}(t, X_t, \eta_t) = \max_{C_t, \alpha_t} u(C_t) + \beta p_t E_t[V^{pub}(t + 1, X_{t+1}, \eta_{t+1})]$$

s.t. $X_{t+1} = Y_{t+1} + (X_t - C_t)R_{t+1}^P$

s.t. $R_{t+1}^P = \alpha_t R_{t+1} + (1 - \alpha_t)R^f$

s.t. Labor income process

where $R_{t+1} \sim N(\mu, \sigma^r)$ and $p_t$ is date-$t$ conditional survival probability
Model

Private Worker

- Private workers receive
  1. different wage process $Y^{priv}_t = \lambda Y^{pub}_t$
  2. DC plan + social security $ss^{priv}$ in retirement
  3. labor income tax $\tau$

- The tax $\tau$ is used to fund (i) public sector wages and (ii) shortfalls in pension fund
  - Tax depends on pension funded status $\chi$
An age $t$ private worker solves the Bellman

\[
V_{\text{priv}}^t(t, X_t, \eta_t, \chi) = \max_{C_t, \alpha_t} u(C_t) + \beta p_t E_t [V_{\text{priv}}^t(t + 1, X_{t+1}, \eta_{t+1}, \chi')] \\
\text{s.t. } X_{t+1} = Y_{t+1}(1 - \tau(\chi')) + (X_t - C_t)R_{t+1}^p \\
\text{s.t. } R_{t+1}^p = \alpha_t R_{t+1} + (1 - \alpha_t)R^f \\
\text{s.t. } \text{Income Process} \\
\text{s.t. } \chi' \sim F(\chi)
\]

where $F(\chi)$ is conditional distribution of pension funded status and \( \tau(\chi') \) maps funded status $\rightarrow$ tax.
Model
Government Policy

- Gov.'t observes population $M$ with cohort distribution 
  $\{\phi_t\}_{t=20}^{100}$
  - Proportion of public workers $q \in [0, 1]$

- The government has three tasks:
  1. portfolio share $\alpha^*$ for pension assets
  2. maintain pension funding constraint
  3. Set tax $\tau$ to fund public wages + pension shortfalls

- The government sets tax $\tau$ to fund wages and pension shortfalls; thus,

$$\tau = \underbrace{\tau^y}_{\text{constant labor income}} + \underbrace{\tau^p}_{\text{stochastic pension insurance}}$$
Pension fund enters year with

- Assets, \( A \)
- Immediate liabilities, \( B \)
- Present value of future liabilities, \( L \)

and sets government contributions \( G \)

Next-period value of assets \( A' = (1 + r^*) (A - B + G) \)

Funding constraint: choose \( G \) such that

\[
\frac{E[A']}{L} \in [\chi, \bar{\chi}]
\]

\( G \) can be positive, negative
Calibration/Application

- Model developed to help guide state pension policy

- Given the set of model parameters,
  - a subset taken as universal
    - Cocco, Gomes and Maenhout [2005]
  - a subset calibrated to state environment

- Application: Minnesota
Baseline Results

**Workers:**
- Private workers accumulate $5 \times$ more pre-retirement wealth
  - $3 \times$ higher savings rates
- Private workers decrease portfolio risk with age

**Government:**
- Average pension insurance tax is negative
  - But volatile
- Pension funded status stays within bounds

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$^1$In practice, assume defined contribution plans offer optimal portfolio and savings rule as default options.
Policy Experiment

- Perform following hybrid DB/DC reform:
  1. Suspend pension benefits according to age-based accrual rule
     - new benefit $\tilde{b}(t) = \frac{t-20}{45} \cdot b$
  2. Employees enroll in DC plan
  3. Increase wages
  4. How much do wages need to increase to keep welfare constant?
Welfare-Constant Wage Increases Vary By Age

Table 2: Public Worker Welfare Effect (CE%)
How Does Transition Affect Taxpayers?

- Annual benefits/total liabilities decline over time

- **Result**: Providing welfare-neutral compensation of public workers costs taxpayers
  - Leads to welfare loss
  - Why?

- However, young private workers prefer a *no pension plan* scenario

- Idea: it’s the transition that hurts

- A caveat: (i) U.S. public funds are not running surpluses and (ii) tax rebates not realized
  - Gov.’t funding & tax policy not realistic
Conclusion

- U.S. public pension plans are in need of reform
- An applied model to make normative statements for various pension reforms
- For hybrid DB/DC reform,
  - Young public workers require \( \sim 5\% \) wage compensation
  - Older public cohorts range from 10-25%
  - All private workers hurt by transition

Next Steps
- More realistic state budget/tax policy
- Differential wage process (not just scaling)
- Demographic effect on taxpayers
- Evaluation of existing reforms
Public Pensions–A Drag on State Finances

- In 2016, the average funded ratio for public funds was 66% (Pew Foundation Research)

- The principal factors leading to shortfalls are:
  - Insufficient contributions
  - Below expectation investment returns
  - Non-market discount rates

- One outcome: shifting burden to future generations

- Most public (private) employees are DB (DC)
U.S. Public Pension Reforms

**Utah (2010)**
- Bound Cost of Living Adjustments (COLAs) at 2.5%
- New employees enroll in pure DC plan or hybrid DB/DC plan
- Increase employer contributions

**Rhode Island (2011)**
- Suspend COLAs
- Current workers enroll in hybrid DB/DC plan
- Discount rate from 8.25% → 7.5%

**Oklahoma (2014)**
- Create standalone DC plan for new employees
- Bound discount rate at 7.5%
- Increased employer contributions for undfunded liability

**Pennsylvania (2014)**
- Created hybrid DB/DC plan and DC plan for new employees
- Current employees still DB
- Benefit reduction for new employees
U.S. Public Pension Reforms

**Colorado (2018)**
- Hybrid DB/DC and pure DC plan (since 2006)
- Discount rate lowered 7.5% → 7.25%
- COLAs frozen at 1.5%
- Employer and Employee contributions increase

**Minnesota (2018)**
- Discount rate lowered 8% → 7.5%
- COLAs reduced to 1.5%
- Employer/employee contribution rates increase
- Benefit decrease for employees
  - Early retirement subsidies removed
Pension Aggregates

- Given an individual pension benefit \( b \) in retirement, the aggregate period benefit is

\[
B = qM b \sum_{t=65}^{100} \phi_t
\]

- In a stationary environment (without cohort age change), the present value of liabilities is

\[
L = \frac{1 + r^f}{r^f} B
\]

discounted with the risk-free rate.
Pension Funding Rule

- Define $\chi^\circ$ as the expected, next-period value of pension funded status (w/o government contributions $G$):

$$\chi^\circ = \frac{E[(1 + r^*)(A - B)]}{L}$$

- Government contributions are determined via

$$G(\chi^\circ) = \begin{cases} \frac{L}{E[1+r^*]}[\chi - \chi^\circ] & \text{if } \chi^\circ \in (-\infty, \chi) \\ 0 & \text{if } \chi^\circ \in [\chi, \bar{\chi}] \\ \frac{L}{E[1+r^*]}[\bar{\chi} - \chi^\circ] & \text{if } \chi^\circ \in (\bar{\chi}, \infty) \end{cases}$$

- Given the required contribution, the government chooses $\tau^P$ such that

$$G = \tau^P M \sum_{t=20}^{65} \phi_t (1 - q_t) E[Y_t]$$
## Universal Calibrated Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>.96</td>
<td>discount factor</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>10</td>
<td>risk aversion</td>
</tr>
<tr>
<td>$T$</td>
<td>65</td>
<td>retirement age</td>
</tr>
<tr>
<td>$r_f$</td>
<td>.02</td>
<td>risk-free rate</td>
</tr>
<tr>
<td>$\mu^r$</td>
<td>.06</td>
<td>risky mean return</td>
</tr>
<tr>
<td>$\sigma^r$</td>
<td>.157</td>
<td>risky vol</td>
</tr>
<tr>
<td>$\sigma^\nu$</td>
<td>.074</td>
<td>transitory shock</td>
</tr>
<tr>
<td>$\sigma^\eta, \rho$</td>
<td>.011,1</td>
<td>persistent shock</td>
</tr>
<tr>
<td>$p_t$</td>
<td>–</td>
<td>survival prob</td>
</tr>
</tbody>
</table>

**Table:** Universal Model Parameters
## State Calibrated Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>b</td>
<td>21.2k</td>
<td>Pension</td>
</tr>
<tr>
<td>$M$</td>
<td>2.86 mil</td>
<td>Total population</td>
</tr>
<tr>
<td>$\phi_t$</td>
<td>–</td>
<td>Age cohort dist.</td>
</tr>
<tr>
<td>q</td>
<td>0.18</td>
<td>Prop. public workers</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>1.154</td>
<td>Wage differential</td>
</tr>
<tr>
<td>$\chi, \bar{\chi}$</td>
<td>.7, 1.2</td>
<td>Pension bounds</td>
</tr>
<tr>
<td>$\alpha^*$</td>
<td>.8</td>
<td>Plan risky asset share</td>
</tr>
<tr>
<td>$ss^{pub}, ss^{priv}$</td>
<td>20.8, 22.08</td>
<td>Social security benefit</td>
</tr>
</tbody>
</table>

**Table:** Minnesota Model Parameters
Data Details

- Labor income: PSID, Cocco, Gomes and Maenhout [2005]
- Universal parameters: Cocco, Gomes and Maenhout [2005]
- Investment policy: 2016 Minnesota State Board of Investment
- Age demographics, population: census, MN Annual Workforce Report
- Wage differential: Keefe [2011], Employer Costs for Employee Compensation Survey (BLS)
- Mortality rates: National Center for Health Statistics
Labor Income Process

- Source: PSID, Cocco, Gomes and Maenhout [2005]
- Unit: individual, male with college education
Minnesota Age Demographics

Figure 18: Distribution of Executive Branch Employees by Age Cohort and Generation (2015)

Figure: 2015 Minnesota Workforce Report
<table>
<thead>
<tr>
<th>Asset</th>
<th>Portfolio Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Equity</td>
<td>.45</td>
</tr>
<tr>
<td>Non-US Equity</td>
<td>.15</td>
</tr>
<tr>
<td>Alternative</td>
<td>.20</td>
</tr>
<tr>
<td>Bonds</td>
<td>.18</td>
</tr>
<tr>
<td>Cash</td>
<td>.02</td>
</tr>
</tbody>
</table>

**Table:** 2016 Minnesota State Board Annual Report
Calibrated labor income $Y_t$ is after-tax such that $Y_t = (1 - \tau^y) \tilde{Y}_t$.

Initial labor tax $\tau^y$ set via

$$\tau^y = \frac{q}{1 - q} \frac{\sum_t \phi_t E[Y^\text{pub}_t]}{\sum_t \phi_t E[Y^\text{priv}_t]}$$

Given increase of $\lambda > 0$ to public wages, new after-tax income written

$$Y^{priv*}_t = Y^{priv}_t (1 - \frac{\lambda \tau^y}{1 - \tau^y})$$
Minnesota Funded Status

► Using four primary state funds/assets ($, bil):
  1. Teachers (21)
  2. GERF (20)
  3. State Employees (12)
  4. St. Paul Teachers (1)

► Respective funded status': (.768, .778, .852, .645)

► Leads to representative funded status of 0.79
Wealth Accumulation

Average Lifecycle Wealth

Wealth $X_t$ (Thousands)

Age

- Public
- Private
Savings Rates

Average Lifecycle Savings Rate

Fraction of Labor Income Saved

Age

20 30 40 50 60

Public

Private

Return
Lifecycle Portfolio Choice

Public Portfolio Decisions

Share of Risky Asset vs. Wealth $X_t$ ($\$, Thousands)

- Blue line: Age 25
- Orange line: Age 40
- Green line: Age 50
- Red line: Age 60
Lifecycle Portfolio Choice

Private Portfolio Decisions

Share of Risky Asset vs. Wealth $X_t (\$, Thousands)$

- Blue: Age 25
- Orange: Age 40
- Green: Age 50
- Red: Age 60
Lifecycle Portfolio Choice

Average Lifecycle Portfolio Decision

Share of Risky Asset

Age

Public
Private
Tax Dynamics

Average Pension Tax $\tau^p$

Years Since Policy Inception

$\tau^p$

Return
Pension Dynamics

Average Pension Funded Status

Years Since Policy Inception

Funded Status
### Accrual Rule

<table>
<thead>
<tr>
<th>Age</th>
<th>New Benefit ($, Thousands)</th>
<th>Old Benefit ($, Thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>2.4</td>
<td>21.2</td>
</tr>
<tr>
<td>40</td>
<td>9.4</td>
<td>21.2</td>
</tr>
<tr>
<td>50</td>
<td>14.1</td>
<td>21.2</td>
</tr>
<tr>
<td>60</td>
<td>18.8</td>
<td>21.2</td>
</tr>
</tbody>
</table>
Evolution of Frozen Pension Liabilities

Aggregate Annual Benefits

Total Liabilities

$\,\text{Billions}$

$0$ $20$ $40$ $60$ $80$

$0$ $20$ $40$ $60$ $80$

$0$ $2$ $4$ $6$ $8$ $10$ $120$

$0$ $20$ $40$ $60$ $80$

Years Since Plan Freeze

Years Since Plan Freeze
Public Worker Welfare

Frozen Plan with Wage Compensation

Table 2: Public Worker Welfare Effect (CE%)
Private Worker Welfare
Frozen Plan with Wage Compensation (75% Funded Status)
Private Worker Welfare

Frozen Plan with Wage Compensation (100% Funded Status)
Private Worker Welfare

No Pension Plan with Wage Compensation (75% Funded Status)
Private Worker Welfare

No Pension Plan with Wage Compensation (100% Funded Status)

Private Worker Welfare Effect (CE%)